CLAIMS:

1. A method for determining the source of coke deposits in overhead equipment in a heavy hydrocarbon thermal conversion process unit for converting heavy hydrocarbon feedstock to lower boiling products, comprising the steps of:

(a) introducing an effective amount of at least one nonvolatile metal-containing organic compound into a heavy hydrocarbon feedstock, which said nonvolatile metal-containing organic compound is completely soluble in said heavy hydrocarbon feedstock;

(b) converting at least a fraction of said heavy hydrocarbon feedstock containing said nonvolatile metal-containing organic compound in a thermal conversion zone of said process unit to lower boiling products and resulting in a vapor product stream;

(c) passing said vapor product stream through at least one piece of overhead equipment associated with said thermal conversion process unit wherein coke deposits form in at least one piece of said overhead equipment;

(d) analyzing said coke deposits for the metal of said nonvolatile metal-containing compound; and

(e) determining that the source of coke deposits in said at least one piece of overhead equipment results from: (i) condensation of said vapor product stream or (ii) entrainment of feed droplets in said vapor product stream.

2. The method of claim 1 wherein the thermal conversion process unit is a fluidized bed coking unit.

3. The method of claim 2 wherein the nonvolatile metal-containing organic compound is selected from metalloporphyrins, metal acetylocetonates, and metal naphthenates.

4. The method of claim 3 wherein the nonvolatile metal-containing organic compound is copper naphthenate.

5. The method of claim 1 where at least one piece of overhead equipment is a cyclone.

6. The method of claim 5 wherein the nonvolatile metal-containing organic compound is copper naphthenate.

7. The method of claim 1 wherein the heavy hydrocarbon feedstock is selected from the group consisting of vacuum resids, atmospheric resids, heavy and reduced petroleum crude oil, pitch, asphalt, bitumen, coal slurries, coal liquefaction bottoms and the heaviest fractions of tar sand oil and shale oil.

8. The method of claim 6 wherein the heavy hydrocarbon feedstock is selected from the group consisting of vacuum resids, atmospheric resids, heavy and reduced petroleum crude oil, pitch, asphalt, bitumen, coal slurries, coal liquefaction bottoms, and the heaviest fractions of tar sand oil and shale oil.

9. A method for determining the source of coke deposits in overhead equipment in a fluidized bed coking unit for converting heavy hydrocarbon feedstock to lower boiling products, comprising the steps of:

(a) introducing from about 10 to 1000 wppm of copper naphthenate into a heavy hydrocarbon feedstock;

(b) converting at least a fraction of said heavy hydrocarbon feedstock containing said copper naphthenate in a thermal

conversion zone of said coking unit to lower boiling products and resulting in a vapor product stream;

(c) passing said vapor product stream through at least one piece of overhead equipment associated with said coking unit wherein coke deposits form in at least one piece of said overhead equipment;

(d) analyzing said coke deposits for the copper; and

(e) determining that the source of coke deposits in said at least one piece of overhead equipment results from: (i) condensation of said vapor product or (ii) entrainment of feed droplets in said vapor product stream.

10. The method of claim 9 where at least one piece of overhead equipment is a cyclone

11. The method of claim 9 wherein the heavy hydrocarbon feedstock is selected from the group consisting of vacuum resids, atmospheric resids, heavy and reduced petroleum crude oil, pitch, asphalt, bitumen, coal slurries, coal liquefaction bottoms and the heaviest fractions of tar sand oil and shale oil.

12. A method for thermally converting a heavy hydrocarbon thermal conversion process unit for converting heavy hydrocarbon feedstock to lower boiling products, comprising the steps of:

(a) introducing from about 10 to 1000 wppm of at least one nonvolatile metal-containing organic compound into a heavy hydrocarbon feedstock, which said nonvolatile metal-containing organic compound is substantially soluble in said heavy hydrocarbon feedstock;

(b) injecting said hydrocarbon feedstock containing said nonvolatile metal-containing organic compound through a feed nozzle to said thermal conversion process unit;

(c) converting at least a fraction of said heavy hydrocarbon feedstock containing said at nonvolatile metal-containing organic compound in a thermal conversion zone of said thermal conversion process unit to lower boiling products and resulting in a vapor product stream;
(d) passing said vapor product stream through at least one piece of overhead equipment associated with said thermal conversion process unit wherein coke deposits form in at least one piece of said overhead equipment;
(e) analyzing said coke deposits for the metal of said nonvolatile metal-containing compound;
(f) determining that the source of coke deposits in said at least one piece of overhead equipment results from: (i) condensation of said vapor product or (ii) entrainment of feed droplets in said vapor product stream;
(g) lowering the temperature of said thermal conversion process unit or increasing the temperature of said vapor product stream by an effective amount when the coke deposits are due to condensation of vapors; or
(h) adjusting the feed nozzles or mixers by an effective amount when the coke deposits result from feed entrainment.

13. The method of claim 12 wherein the thermal conversion process unit is a fluidized bed coking unit.

14. The method of claim 12 wherein the nonvolatile metal-containing organic compound is selected from metalloporphyrins, metal acetylocetonates, and metal naphthenates.

15. The method of claim 14 wherein the nonvolatile metal-containing organic compound is copper naphthenate.

16. The method of claim 12 where at least one piece of overhead equipment is a cyclone.

17. The method of claim 12 wherein the heavy hydrocarbon feedstock is selected from the group consisting of vacuum resids, atmospheric resids, heavy and reduced petroleum crude oil, pitch, asphalt, bitumen, coal slurries, coal liquefaction bottoms and the heaviest fractions of tar sand oil and shale oil.

18. A method for thermally converting a heavy hydrocarbon thermal conversion process unit for converting heavy hydrocarbon feedstock to lower boiling products, comprising the steps of:

(a) introducing from about 10 to 1000 wppm of copper naphthenate into a heavy hydrocarbon feedstock wherein said copper naphthenate is substantially soluble;

(b) injecting said hydrocarbon feedstock containing said copper naphthenate through a feed nozzle to said thermal conversion process unit;

(c)converting at least a fraction of said heavy hydrocarbon feedstock containing said copper naphthenate in a thermal conversion zone of said coking unit to lower boiling products and resulting in a vapor product stream;

(d) passing said vapor product stream through at least one piece of overhead equipment associated with said coking unit wherein coke deposits form in at least one piece of said overhead equipment;

(e) analyzing said coke deposits for the copper;

determining that the source of coke deposits in said at least one piece of overhead equipment results from: (i) condensation of said vapor product or (ii) entrainment of feed droplets in said vapor product stream;

(f) lowering the temperature of said thermal conversion process unit or increasing the temperature of said vapor product stream by an effective amount when the coke deposits are due to condensation of vapors; or

(g) adjusting the feed nozzles or mixers by an effective amount when the coke deposits result from feed entrainment.

19. The method of claim 18 wherein the thermal conversion process unit is a fluidized bed coking unit.

20. The method of claim 18 where at least one piece of overhead equipment is a cyclone.

21. The method of claim 18 wherein the heavy hydrocarbon feedstock is selected from the group consisting of vacuum resids, atmospheric resids, heavy and reduced petroleum crude oil, pitch, asphalt, bitumen, coal slurries, coal liquefaction bottoms and the heaviest fractions of tar sand oil and shale oil.